

# NASA TECH BRIEF



NASA Tech Briefs are issued to summarize specific innovations derived from the U.S. space program, to encourage their commercial application. Copies are available to the public at 15 cents each from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

## Multiple-Mask Chemical Etching

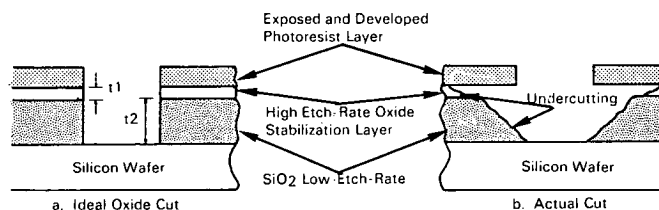


Fig. 1. Standard Semiconductor Photoetching Process



Fig. 2. Multiple Masking, Technique 1

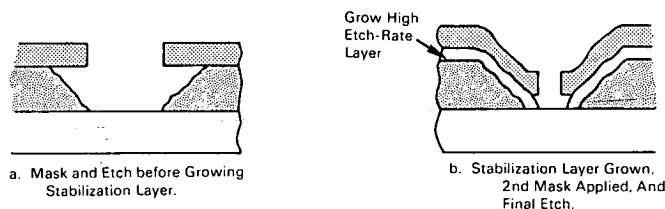


Fig. 3. Multiple Masking, Technique 2

### The problem:

Standard chemical etching techniques, which remove semiconductor oxides during the fabrication of integrated circuits, sometimes result in excessive lateral etching. An ideal etched profile is shown in Figure 1; however, in practice, the etchant removes a larger area at the top. If a high etch-rate oxide ( $t_1$ ) is located in the structure, an area will be etched laterally for a distance equal to many oxide thicknesses resulting in the exposure of critical areas of the device.

### The solution:

The lateral etching has been contained by using multiple masking techniques which effectively reduce the total area of the high etch-rate oxide exposed to the chemical etchant.

### How it's done:

One method utilizes a short-term etch which removes only the high etch-rate top layer from the silicon oxide surface. The etchant is neutralized and a second

(continued overleaf)

mask is applied as shown in Figure 2. A second etch is then initiated to cut through the slow etch-rate silicon oxide layer ( $t_2$ ). The second mask preserves the high etch-rate stabilization layer and reduces lateral undercutting because of the reduced opening size ( $m_2$ ) of the second mask.

A second technique, multiple contacts, consists of first masking and etching before the high etch-rate stabilizing oxide layer is grown. Figure 3a shows the first photoresist mask and resulting etch; the first mask is removed and the top oxide then grown. A second photoresist mask with slightly smaller openings is then applied to the surface and a second etching follows. As shown in Figure 3b, the stabilizing high etch-rate oxide layer and the original opening are protected from the etchant; the total lateral etch is now less than  $t_1 + t_2$ .

**Note:**

No further documentation is available. Inquiries may be directed to:

Technology Utilization Officer  
Manned Spacecraft Center  
Houston, Texas 77058  
Reference: B69-10221

**Patent status:**

No patent action is contemplated by NASA.

Source: Don Lee Cannon of  
Lockheed Electronics Company  
under contract to  
Manned Spacecraft Center  
(MSC-13114)